PROGRIS RIPORT 23

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011119

`itehu:~kotani/glast.itehu/txt/011119.kotani2.riport23`
`http://lheawww.gsfc.nasa.gov/users/kotani/glast/011119.kotani2.riport23.ps`

1 Have Done

- Developed filters to cut ill-reconstructed events in the balloon flight data.
- Triggered a monitoring observations of SS433 with RXTE. The purpose of the 30-day-long monitoring observation is to detect a flare from the source in its high state.
- Changed job. My title since October is Assistant Research Scientist at University of Maryland Baltimore County.

2 The Filter Set

The BGD filter set for the BFEM data is still being developed. The latest filter set and the number of photon candidates surviving the set is shown in Table 1 and 2, respectively. Roughly speaking, 0.3 % of triggering events survives the filter set. Presumably, this ratio will not be changed drastically in future analysis. As for the BFEM-ACD filter, a fine tuning of the threshold value of the ACD and introduction of a DOCA algorithm are scheduled, but they will not change the current rejection ratio of 90 % so much, unless the threshold value is considerably lowered. Introduction of a filter based on CAL information may cut a fraction of the remaining photons, but probably not reduce the number by an order. Therefore, the final ratio of remaining events is expected not to differ from the bottom line of Table 2.

2.1 The BFEM-ACD filter

The BFEM-ACD filter cuts events with any ACD hits. Events with an energy exceeding 50 MeV are kept, although they are rare. As shown in Run 55 in Table 2, 90 % of events lights at least one tile and thus is cut. Presumably, a scheduled revision of the threshold value will not change the ratio drastically. In near future, a DOCA algorithm is introduced into the filter, which will save some high-energy photons with a splash. A simulation study with `balloonsim` is going on to study the relation between the incident energy and the number of lit tiles. The simulation will affects high-energy events with an energy $\gtrsim$ GeV.

2.2 The track-quality filter

Does anybody understand this filter? I don't. This filter cuts 3/4 of the events, i.e., the ratio of remaining events would increase from 3 % to 12 % without this filter. But what does it cut?

2.3 The CAL-Δt filter

Strange events full of X-CAL signals but no Y-CAL signal were found in the remaining photon candidates[3, 4]. According to Grove[2], successive events with a separation shorter than 200 μs causes fake signals in the CAL. This filter cuts events with too many CAL signals. The determination of the deposit energy used here is preliminary. In Run 55, 10 % of events is cut, and that is roughly consistent with the L1T rate of 2 kHz. The ejection ratio of 10 % corresponds to a threshold Δt of 50 μs

2.4 The Albedo-e filter

The name "albedo-e" is not appropriate anymore, since this filter cuts not only albedo particles but various events with ill-reconstructed track or suspicious pattern in the TKR. This is the most elaborate filter in the set, although it is not expected to cut many events.

The Λ filter, formerly known as the Albedo-e1 filter, cuts events if a Λ shape is not reconstructed. Events with a large energy deposit should be also kept, because the high-energy γ ray does not necessarily make a clear Λ. The energy dependence will be implemented.

The ESC-TRK filter, formerly known as the Albedo-e2 filter, cuts events with no energy information, i.e., no CAL hit. If all *exiting* tracks of such an event point the CAL, it gives us a bit of information that the created electrons don't have energy enough to penetrate the TKR layers, and thus it is kept. The threshold energy of 1 MeV should be calibrated in future based on a simulation study. Example events cut by this filter are shown in Fig. 1.

The SGL filter filters events converted in the three Super GLAST Layers, i.e., thick lead layers. If a γ ray is converted in the bottom SGL, all tracks must point the CAL. If converted in the other layers, the best track must point the CAL. Example events cut by this filter are shown in Fig. 2. This filter may be too tight and complicated, and may be changed.

The ABV-VTX filter cuts events with a track above the vertex and events with more than two hits above the vertex. Example events cut by this filter are shown in Fig. 3. Some γ rays converted in a dead strip are cut with this filter or the Hit-NR-VTX filter. What should we do with such events? Do we need them?

The Hit-NR-VTX filter cuts events with a hit within a cube just above the vertex. Examples of events cut with this filter are shown in Fig. 4. Events with a hit which is near the vertex and does not belong to any tracks are suspicious and to be removed. This filter also cuts γs converted in a dead strip.

Thus we have 1007+352 photon candidates. The spectra of all the incident events and of the photon candidates are shown in Fig. 5 and 6. Further investigation is going on.

3 Installing the GLAST Software

I have installed the GLAST software such as `bfemApp`, `pdrApp`, `balloonsim`, `EventDisplay`, and `ROOTWriter`, and the tools necessary for them such as `ROOT`, `Geant4`, and `cmt`. A considerable fraction of work time is absorbed in these installing, unsuccessful building, replacing a sub-package with an *older* one, re-building, running, encountering a segmentation error, waiting for e-mail from the author and/or/i.e. Heather, re-re-building, etc. Sounds horrible? Yes, indeed. Don't worry, you can avoid these procedures unless:

- You are obsessed to have everything run in your Linux box.
- You get masochistic pleasure from a compilation error.
- You are a developer.
- All of above.

If you are unfortunately categorized in any and have to install the GLAST software into a Linux machine, my memo bellow may help. The essence is: *Don't trust cmt.*

`cmt` is a tool to manage complicated software consisting of many sub-packages of various versions[1], and it is said to allow you to install and build them with a few sophisticated commands like this:

1. `cmt checkout -R -r v1r9 bfemApp`

2. `cd bfemApp/v1r9/cmt`
3. `cmt broadcast 'cmt config'`
4. `cmt broadcast 'gmake'`

However, as you know very well if you have tried installing, things do not go so easily. In the case of `bfemApp`, the following steps are mandatory. If any procedure is omitted, you can not build the code. They were discovered after numerous trials by many people.

1. `cmt checkout -R -r v1r9 bfemApp`
2. Delete unnecessary sub-packages which `cmt` downloaded. Consult `bfemApp/v1r9/cmt/requirements` and daughter `requirements` files to check which sub-package is appropriate.
3. Rewrite `gui/v2r6p1/cmt/requirements` to tell `cmt` where your `LessTif 2.0` libraries are. Add "`-L/usr1/local/LessTif/Motif2.0/lib`" and "`-I /usr1/local/LessTif/Motif2.0/include`" to `gui_X_linkopts` and `cppflags`, respectively.
4. Rewrite `ROOT/v3r0p9/mgr/requirements` to tell `cmt` where your `ROOT` libraries are. Change `ROOT_PATH` from "`$ROOT_DIR/v3.00.06/@sys/root`" to "`$ROOT_DIR`".
5. Unset the `CMTPATH` environment variable. `cmt` won't work if it is set. I don't know why.
6. `cd bfemApp/v1r9/cmt`
7. `cmt broadcast 'cmt config'`
8. `cmt broadcast 'gmake'`

Please let me know if you know other tips.

4 To Do

- Run `balloonsim` and determine the parameters used in the filters, which are now determined rather arbitrarily.
- Convert GRB simulator written in IDL script into a `Gaudi` module.
- Be out from 2001/11/22. Return on 2001/12/10.

References

[1] Arnault, 2001/06/02, http://www.lal.in2p3.fr/SI/CMT/CMT.htm

[2] Grove, 2001/09/13, http://gamma.nrl.navy.mil/glast/Balloon_flight_2001/analysis010913.htm

[3] Kotani & Hartman, 2001/10/10, http://lheawww.gsfc.nasa.gov/users/kotani/glast/011010.kotani2balloonmeeting/

[4] Kotani & Hartman, 2001/10/18, http://lheawww.gsfc.nasa.gov/users/kotani/glast/011018.kotani2balloonmeeting/

Table 1: BGD filter set for BFEM in appfilter ver. 1.3

These definitions/codes are under development and subject to change. This package will be available soon at http://lheawww.gsfc.nasa.gov/users/kotani/glast/bgdfilter/appfilter.1.3.tar.gz.

<table>
<tr><th>Name</th><th>Aux_CutFlag</th><th>Code/Definition</th></tr>
<tr><td>BFEM ACD</td><td>2^{14}</td><td>ACD_TileCount = 0 || Cal_Energy_Deposit > 50 MeV</td></tr>
<tr><td>Track Quality
(Jose's filter)</td><td>2^{19}</td><td>TKR_qual > 10. && TKR_Gamma_zdir ≠ 0.
&& {(Cal_Corr_Energy > 0 && TKR_t_angle < kalfit && |TKR_Fit_Kink| < kalfit)
|| (Cal_Corr_Energy ≤ 0 && $\mathrm{TKR\_t\_angle} - \frac{35}{\vert\mathrm{TKR\_Gamma\_zdir}\vert} < 0$ && $\vert\mathrm{TKR\_Fit\_Kink}\vert - \frac{35}{\vert\mathrm{TKR\_Gamma\_zdir}\vert} < 0$)}
$\mathrm{kalfit} = 3.5 \times 10^{-3} \times \left(\frac{3.0}{\mathrm{Corr\_Energy}\,\vert\mathrm{TKR\_Gamma\_zdir}\vert} + \frac{2.18}{\sqrt{\mathrm{Corr\_Energy}}\,\vert\mathrm{TKR\_Gamma\_zdir}\vert}\right)$</td></tr>
<tr><td>CAL Δt</td><td>2^{21}</td><td>CalLog < 85× Cal_Energy_Deposit/700 + 15</td></tr>
<tr><td>A/e Λ (Albedo_e1)</td><td>2^{22}</td><td>TKR_Fit_Type ≥ 22</td></tr>
<tr><td>A/e ESC TRK (Albedo_e2)</td><td>2^{23}</td><td>Cal_Energy_Deposit > 1 MeV || No escaping track</td></tr>
<tr><td>A/e SGL</td><td>2^{24}</td><td>(TKR_First_XHit ≠ 10 || No escaping track)
&& (TKR_First_XHit < 8 || 9 < TKR_First_XHit || Best track points CAL)</td></tr>
<tr><td>A/e Wide (Albedo_e4)</td><td>2^{25}</td><td>(best track vector · pair track vector)> 0.5</td></tr>
<tr><td>A/e ABV VTX</td><td>2^{26}</td><td>No track above vertex && No more hits than 2 above vertex</td></tr>
<tr><td>A/e Hit NR VTX</td><td>2^{27}</td><td>No hits within 10 cm of vertex</td></tr>
</table>

Table 2: Photon candidates surviving the filter set

The "each" column shows the effect of each filter if applied solely. The "accumulative" column shows the accumulative effect of all the filters. The "all but" column shows the effect of all the other filters without it. The "only" column shows the events cut by the filter but not cut by any others. All ratios are to the number of events triggering L1 of 104820. Some cells are left blank since a bug was found in the calculation.

Run 53

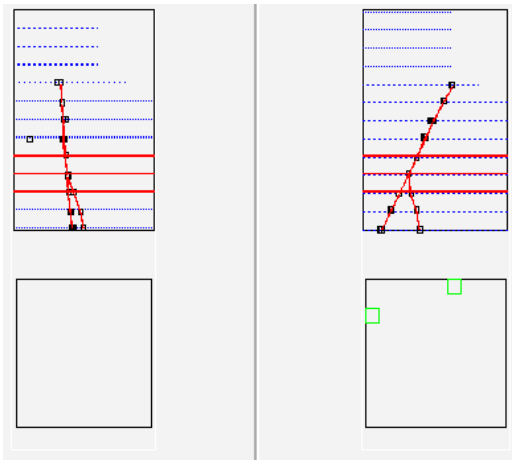
Filter	Each		Accumulative		All but		Only	
	#	Ratio	#	Ratio	#	Ratio	#	Ratio
L1T	30529	1	30529	1	357	0.0116	0	0.0000
BFEM ACD	3294	0.107	3294	0.1078	1062	0.0347	705	0.0230
Track Quality	23898	0.782	1110	0.0363	561	0.0183	204	0.0066
CAL Δt	27785	0.910	1068	0.0349				
A/e Λ	5854	0.191	727	0.0238	551	0.0180	194	0.0063
A/e ESC TRK	15413	0.504	591	0.0193	397	0.0130	40	0.0013
A/e SGL	28488	0.933	520	0.0170	415	0.0135	58	0.0019
A/e Wide	30438	0.997	519	0.0170	357	0.0116	0	0.0000
A/e ABV VTX	23745	0.777	492	0.0161	362	0.0118	5	0.0001
A/e Hit NR VTX	18473	0.605	357	0.0116	492	0.0161	135	0.0044

Run 54

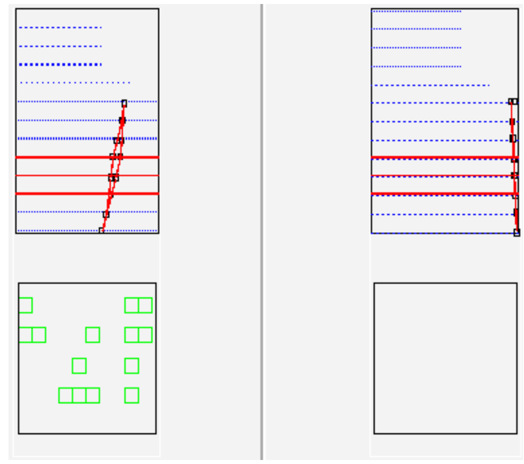
Filter	Each		Accumulative		All but		Only	
	#	Ratio	#	Ratio	#	Ratio	#	Ratio
L1T	109866	1	109866	1	1007	0.0091	0	0.0000
BFEM ACD	17063	0.155	17063	0.1553	4702	0.0427	3695	0.0336
Track Quality	60876	0.554	4189	0.0381	2226	0.0202	1219	0.0110
CAL Δt	97783	0.890	3654	0.0332				
A/e Λ	33000	0.300	2634	0.0239	1485	0.0135	478	0.0043
A/e ESC TRK	50717	0.461	1818	0.0165	1156	0.0105	149	0.0013
A/e SGL	96079	0.874	1536	0.0139	1206	0.0109	199	0.0018
A/e Wide	109206	0.993	1527	0.0138	1015	0.0092	8	0.0000
A/e ABV VTX	91954	0.836	1454	0.0132	1033	0.0094	26	0.0002
A/e Hit NR VTX	71993	0.65	1007	0.0091	1454	0.0132	447	0.0040

Run 55

Filter	Each		Accumulative		All but		Only	
	#	Ratio	#	Ratio	#	Ratio	#	Ratio
L1T	104819	1	104819	1	352	0.0033	0	0.0000
BFEM ACD	11353	0.108	11353	0.1083	4770	0.0455	4418	0.0421
Track Quality	59997	0.572	1776	0.0169	1370	0.0130	1018	0.0097
CAL Δt	97086	0.926	1630	0.0155	394	0.0037	42	0.0004
A/e Λ	32760	0.312	1193	0.0113	483	0.0046	131	0.0012
A/e ESC TRK	50319	0.480	814	0.0077	398	0.0037	46	0.0004
A/e SGL	91023	0.868	625	0.0059	459	0.0043	107	0.0010
A/e Wide	104120	0.993	619	0.0059	356	0.0033	4	0.0000
A/e ABV VTX	87108	0.831	575	0.0054	358	0.0034	6	0.0000
A/e Hit NR VTX	67687	0.645	352	0.0033	575	0.0054	223	0.0021

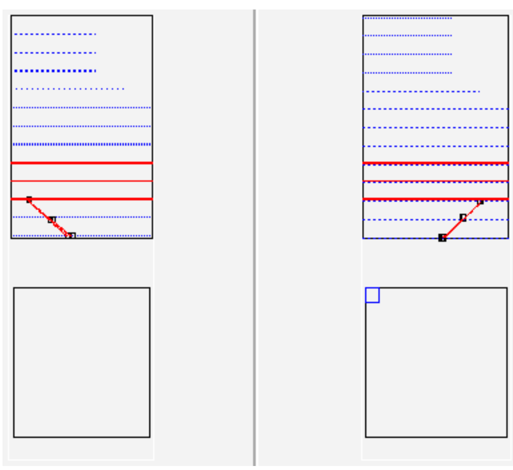


Run 5502, ID 199420.

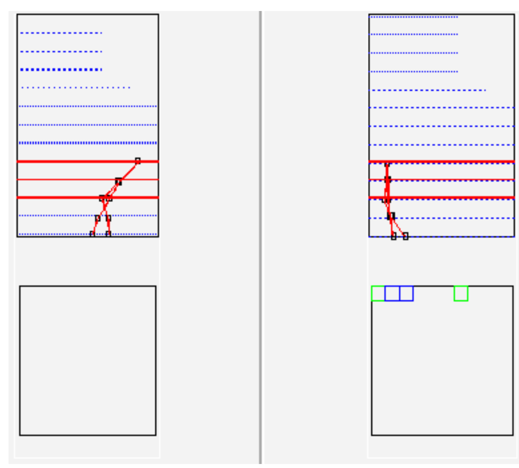


Run 5503, ID 83557.

Figure 1: Example events cut by the ESC-TRK filter
An event is cut if the deposit energy is zero or very small and if any of its exiting tracks miss the CAL. Something is wrong with the right event. This kind of event should be cut with the CAL-Δt filter, not with this ESC-TRK filter. The CAL-Δt filter doesn't work for this event?

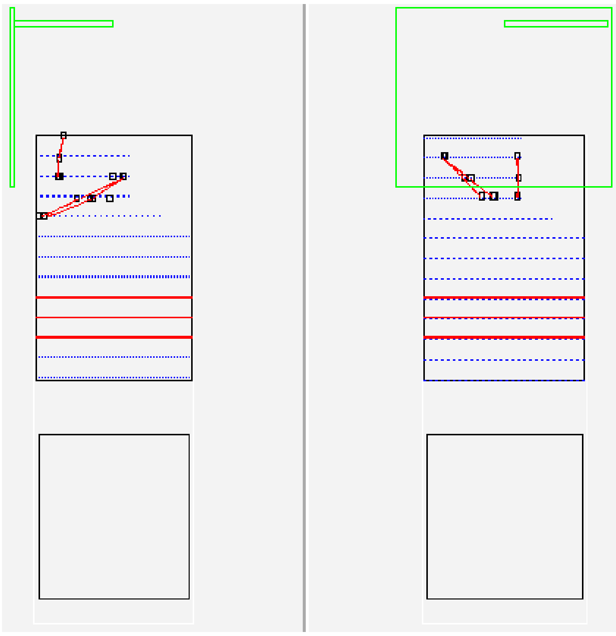


Run 5500, ID 234777.

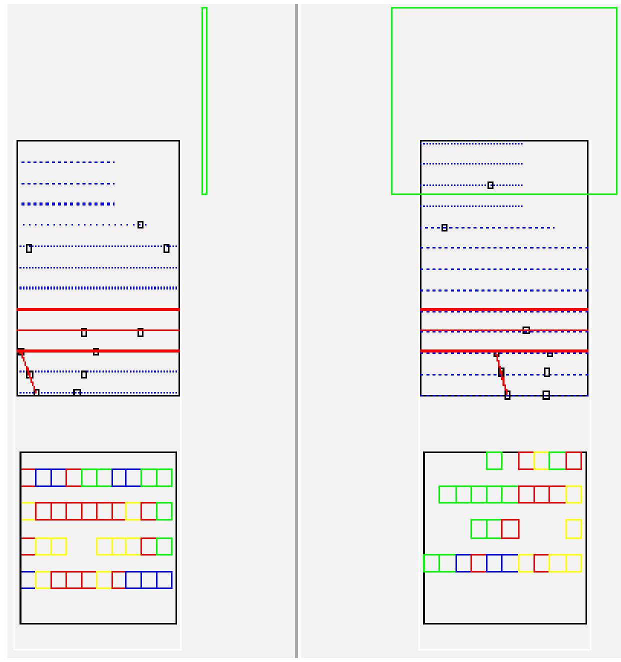


Run 5500, ID 245358.

Figure 2: Example events cut by the SGL filter
An event converted in the bottom SGL must have all of its exiting tracks pointing the CAL. An event converted in other SGLs must have its best track pointing the CAL. A track is considered pointing the CAL if it is aimed at the bottom of the first X CAL layer.

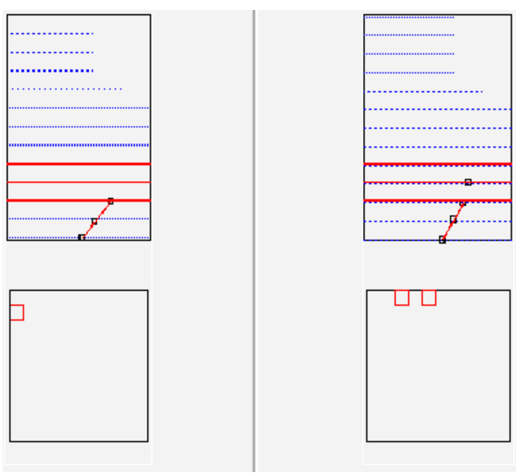


Run 5502, ID 74728.

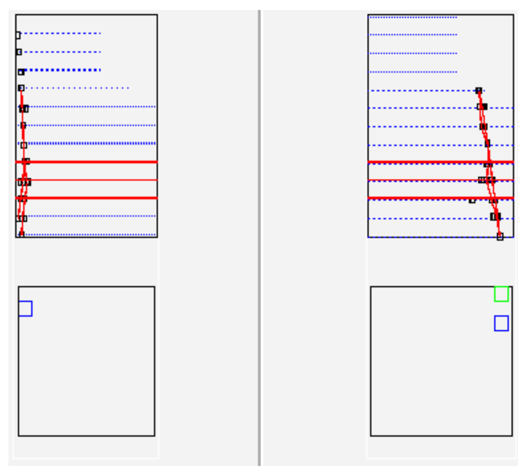


Run 5506, ID 146445.

Figure 3: Example events cut by the ABV-VTX filter
An event is cut if there are two events or more above the vertex or if there are any tracks above the vertex. This filter cuts very abnormal events. They are not so many.



Run 5500, ID 249692.



Run 5500, ID 125136.

Figure 4: Example events cut by the Hit-NR-VTX filter
An event with a hit within a 10^3 cm^3 cube just above the vertex. Because it is difficult to distinguish an excess hit from the hit recognized as the vertex by the reconstruction algorithm, hits in the same plane as the vertex are ignored. As shown in the right, γs converted in a dead strip are also cut with the Hit-NR-VTX filter.

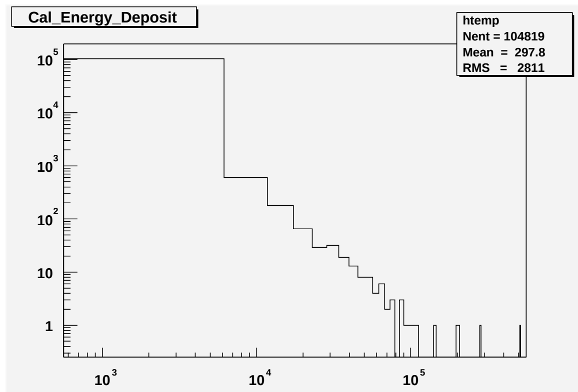


Figure 5: Spectrum of all events

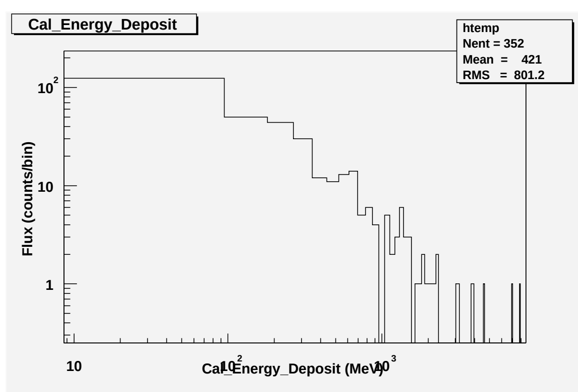


Figure 6: Spectrum of remaining photon candidates